

# **Fifth Annual Conference on Carbon Capture & Sequestration**

*Steps Toward Deployment*

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*Regulatory Analysis Session 3-C*

## **Acid Gas Injection in the United States**

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# Overview

- Definition of acid gas injection
- Purpose and methods of research
- Findings
  - Acid gas injection projects in U.S. and Canada
  - Regulatory requirements
  - Similarities and differences between acid gas injection and geologic sequestration of CO<sub>2</sub>
- Conclusion and next steps

## Acid Gas – A Brief Definition

- Acid Gas is a mixture of gaseous impurities which must be removed (via amine absorption) from natural gas or oil before it can be transported
  - Generally no longer acceptable to discharge (“flare”) to the atmosphere
  - Reclaiming sulfur is no longer economically viable
- “Acid” because it is largely hydrogen sulfide and carbon dioxide
- Acid gas is often compressed then disposed via underground injection

# Purpose of Research

- Acid gas injection provides a technical and regulatory analogue for geologic sequestration of CO<sub>2</sub>
- Although acid gas injection has been well documented in Canada, there are few detailed studies of acid gas injection projects and regulatory requirements in the U.S.
- Goals of Project
  - Determine the extent of acid gas injection in the U.S.
  - Evaluate data availability, quality and relevance for future geologic sequestration projects
  - Compare regulatory requirements across States and between the U.S. and Canada to find potential regulatory models and identify any regulatory gaps

# Research Methods

- Inquiries to States and EPA Regions where acid gas injection is occurring (identified by IOGCC)
  - Information requested
    - Number of wells involved in acid gas injection
    - Data on acid gas injected: volumes, gas composition, injection rates
    - Well data: location, depth, operating status, and target formations
    - Purpose of acid gas injection (disposal or EOR)
    - Regulatory requirements for acid gas injection
- Literature searches were used to provide additional information

# State Responses

- 3 States (TX, WY, ND) and 1 EPA Region (for MI) have responded, 1 (NM) still collecting data, 1 (OK) did not respond
- Quantity and quality of the data varies widely
  - TX provided a “data dump” of all wells permitted for hydrogen sulfide
  - WY provided list of disposal wells and electronic access to permits and well records
  - ND provided injection rate, total volume injected, gas composition and permit conditions
  - Region 5 (for MI) provided injection rate, gas composition, and permit conditions
- One site in Utah was identified through literature review
- It was not always possible to distinguish the purpose of the wells from the data provided

## Acid Gas Injection in the U.S. (2004-2005)

- 32 sites with 68 wells
- Only wells injecting a gas component were included (many wells inject liquid & gas)
- Texas and Wyoming have the largest numbers
- Range from very small (e.g., 21 m<sup>3</sup>/d) to very large (e.g., > 2,000,000 m<sup>3</sup>/d)
- Data are recorded though not always easy to obtain

# Comparison of U.S. and Canadian Acid Gas Injection Operations

	Injection Depth (m)	Injection Rate (m <sup>3</sup> /d)	Injection Pressure (kPa)	Gas Composition (%H <sub>2</sub> S/%CO <sub>2</sub> )
<b>U.S.</b>				
Avg	1,813	313,410*	19,848	40/53
Min - Max	630 – 5,420	21 – 2,265,400*	1,480 – 34,575	4/64 – 76/13
<b>Canada</b>				
Avg	1,744	93,200	19,313	42/52
Min - Max	705 – 2,918	2,800 – 900,000	5,915 – 111,292	1/31 – 85/15

\* The LaBarge facility in WY is much larger than all existing U.S. and Canadian facilities and skews the U.S. average to higher than the Canadian average.



# U.S. Regulatory Requirements for AGI Wells

- Generally regulated under the Safe Drinking Water Act's Underground Injection Control Program as Class II wells
- Permitting considerations
  - Injectate properties
  - Reservoir properties (fracture pressure)
  - Wells in Area of Review
  - Well logs, site maps
- Monitoring requirements
  - Injection pressure, flow rate, volume
  - Fluid composition
  - Annulus pressure, annulus liquid loss
  - Mechanical Integrity Testing every 5 years
- Individual States with primary enforcement authority (primacy) may set their own requirements

## Comparison of U.S. and Canadian Regulatory Requirements for AGI Wells

- Permit application requirements are generally similar, but Canada requires more information
- U.S. does not generally require
  - Analyses of reactions of acid gas with geologic formation
  - Studies of acid gas migration
  - Calculation of gas properties
- U.S. requires reporting of volume injected, while Canada collects data on mass injected

# Comparison of Acid Gas Injection and Geologic Sequestration of CO<sub>2</sub>

- Similarities
  - Objective for both is long-term isolation
  - Equipment and processes involved
  - Receiving formations and depths
  - Gas properties
  - Modeling tools and methods
- Differences
  - Size and scale of operations (acid gas volumes are much lower)
  - Composition of Gas (sequestered CO<sub>2</sub> will be purer, i.e., contain less sulfur and therefore be less toxic)
  - Monitoring and verification requirements to meet climate change mitigation goals

## Conclusions

- Acid gas injection is a good analogue for geologic sequestration in terms of equipment design and target reservoirs; however, the anticipated scale of implementation and overall project goals differ
- Carbon dioxide sequestration may require a more unified regulatory framework – risks may differ
- Data on acid gas injection wells are collected by EPA and States but are not consistent or easily retrievable
- Cooperation with industry could provide useful historical information which is not publicly available (e.g. corrosion rates, gas composition)

## Possible Next Steps

- Further data collection
  - Complete data collection from all States with AGI
  - Obtain additional information from States that responded
  - Possibly request relevant data from industry
- Study corrosion rates and well integrity in acid gas injection wells
- Study acid gas plume migration to understand behavior of CO<sub>2</sub> in the subsurface
- Documentation of any leaks or contamination incidents